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*Note to the Editor*

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INFLUENCE OF VACCINATION :

Age, Sex, and Occupation

ON THE  
MORTALITY IN SMALLPOX.

BY

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*(Read before the Epidemiological Society, 10th April, 1872.)*

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# THE INFLUENCE OF VACCINATION:

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IN March, 1871, I brought under the notice of this Society an analysis of 800 cases of small-pox treated in the Hampstead Hospital during the existing epidemic. In the present paper I purpose giving, in a more detailed form, the statistics of a larger number, and from these figures endeavour to show the influence exercised by vaccination, age, sex, and occupation on the rate of mortality in small-pox. I confine myself to personal experience, trusting that a contribution towards the history of the present fatal outbreak by one who has had very great opportunities of observing it, may possess interest.

*Vaccination.*—To show that the mortality amongst patients suffering from small-pox, and who have been previously vaccinated, is very much less than it is amongst those who are not so protected, is, at the present day, but repeating a truism; still, additional figures can do no harm, so I give them. Of 6,221 patients admitted, 1,248 were without marks of vaccination, and of these 638, or 51·12 per cent., died; whilst among the 4,973 who showed proofs of being vaccinated, in only 567 instances did the disease prove fatal, giving a percentage of mortality of 11·40. From these numbers it is seen, that although the number of patients received into the Hospital of the vaccinated class ex-

ceeded the number in the unvaccinated, a fact of which the anti-vaccination League has made vigorous use, the larger number of deaths occurred amongst the unvaccinated.

The general percentage of mortality is 19·36, which is above the average of late epidemics. This has been ascribed by Mr. Marson, who has noticed the same circumstance at the Small-pox Hospital, and whose lengthened experience entitles him to speak on this point with authority, not only to the form of the disease generally being more severe, but also to the large proportion of cases of the malignant and hæmorrhagic type which have come under treatment. This great prevalence of hæmorrhagic small-pox is characteristic of the present outbreak, and seems to depend upon a peculiar development of the epidemic influence.

It is possible for individuals to be vaccinated, and yet not to obtain all the protection they might do, as the vaccination may be inefficiently performed. It may be inefficient either in quality or quantity. As to quality, where there are different observers with possibly different standards, it is very difficult to reduce the results to figures; so, while believing firmly that the character of the vaccine pock exercises an immense influence over its protective power, I am unable to bring statistics to confirm my belief.

With quantity we have not the same difficulty; there are the marks, and they have but to be looked for and counted.

In the 3,555 cases in which the number of marks was noted, and in which the results are given in full in Table I, it is found that the percentage of mortality in those showing one mark is 17·39, showing two 12·17, showing three 10·58, showing four 8·38, showing five and more 6·43—a scale in which the mortality is in inverse ratio to the number of marks seen. The practical deduction to be made from these numbers is that the larger number of places in which we vaccinate the more protection is given. To obtain even a fair average of protection, at least three marks are required, but something is gained by exceeding that number.

An interesting study in connection with the influence of cow-pox over small-pox is to watch the diseases when concurrent. A considerable number of children have come as patients into the Hospital suffering from both vaccinia and variola, and my experience is, that if the cow-pock reach the eighth day before



the small-pox eruption makes its appearance, the latter disease is modified. As the result of the investigations I have been able to make into the question of the period of incubation of small-pox, I have come to the conclusion that in the great majority of cases the small-pox eruption shows itself on the fourteenth day after the reception into the system of the variolous influence; vaccination during the first three or four days of the period of incubation will accordingly be useful—a strong reason for vaccinating persons in a house where small-pox has already shown itself.

Of small-pox after re-vaccination I have not seen much, owing, I believe, to the rarity of its occurrence. Out of the 6,221 cases above mentioned, in only three could any satisfactory proof of previous re-vaccination be discovered. A good many of the patients said, on their admission, that they had been re-vaccinated; but, on pressing the inquiries, it was found that while the operation had been performed no after effects were produced, and that thereupon the doctor had assured them, that as they were not susceptible to the vaccination there was no fear of their taking small-pox. Their presence in the Hospital was sufficient proof of the fallibility of this doctrine, one which is inculcated even yet by many members of the profession.

Our nurses and servants in constant and close attendance on small-pox, when protected by re-vaccination, do not take the disease; and in this respect the experience at the Hampstead Hospital coincides with that at the older Institution at Highgate. I wish it were possible to bring home to the minds and belief of the general public my conviction regarding re-vaccination, namely, *that it is a sure protection against small-pox*. To ensure this protection, re-vaccination producing some local effect must have been performed after the individual had reached 15 years of age. Cases of variola subsequent to re-vaccination are merely the exception that prove the rule; they are more uncommon than second small-pox, and differ also in this way, that whereas the latter are frequently severe, and sometimes fatal, the former are very mild indeed.

*Age*.—The extremes are alike unfavourable in small-pox, as will be seen by a reference to Table II, in which the percentages of mortality are highest at the beginning and end. Taking the unvaccinated class, amongst whom age is the chief modifying

influence, we find the period of minimum mortality to be between the 10th and 20th years of age. Under 5 as many as 70·87 per cent. die, this diminishes to 35·03 per cent. between 10 and 20, and increases gradually to 100 per cent. over 60, but the number in the last category is so small as to possess little value. Amongst the vaccinated the period of minimum mortality is also between 10 and 20, after 20 the increase is proportionally greater than in the unvaccinated, showing that the protective power of vaccination becomes lessened by the efflux of time. Unvaccinated infants under one year of age rarely recovered.

It is worthy of note that cases of small-pox of the hæmorrhagic type, unfortunately in this epidemic so common in adults, were very seldom found amongst the children.

*Sex.*—More males than females were treated, the active work of men bringing them in more frequent contact with the contagion: the numbers were 3,377 males and 2,844 females, of the former 680, or 20·13 per cent. died; of the latter 525, or 18·49 per cent., a higher rate amongst males than females. This is the case both in the vaccinated and unvaccinated classes; but, taking age in conjunction with sex, we find that the lower rate of females is limited to adult life. Separating the patients under 20 from those over that age, the statistics are as follows:—

Males under 20—

Vaccinated admitted 1,210, died 87 = 7·8 per cent.

Unvaccinated „ 491 „ 251 = 51·12 „

Females under 20—

Vaccinated admitted 1,103, died 79 = 7·16 per cent.

Unvaccinated „ 410 „ 225 = 54·87 „

Males over 20—

Vaccinated admitted 1,506, died 248 = 16·46 per cent.

Unvaccinated „ 170 „ 94 = 55·29 „

Females over 20—

Vaccinated admitted 1,154, died 153 = 13·35 per cent.

Unvaccinated „ 177 „ 68 = 38·41 „

What makes the adult male more liable to death when attacked by small-pox than the female?

*Prima facie* one would suppose that the female, from her more

delicate organisation, would stand the worst chance, but figures show that the reverse is the truth. This effect must be produced by something which lowers the vital powers of men—most probably the mode of life.

It may be that the extra wear and tear undergone by them in the capacity of bread-winners may have something to do with it, but I am inclined to ascribe it to the greater prevalence of dissipated and irregular habits amongst men than women. Nothing unfits one to cope with small-pox, and other diseases as well, more than previous dissipation. The likelihood of an imperfectly vaccinated hard drinker recovering from an attack of this disease is, I believe, small.

*Occupation*, like sex, influences the mortality both directly and indirectly: directly, by increasing the number of deaths in the sufferers from the malady; and indirectly, by certain callings bringing those following them in more than average contact with the infectious cause.

Table III, which is a classified list of all occupations, of which we have had more than 10 representatives as patients, exemplifies both influences. The occupations placed in it above the dotted line have amongst the vaccinated a percentage of mortality higher than the average, and those under it, less. By a reference to that table, it will be seen that sedentary employments, contrary to what might have been expected, compare favourably with the others. The greatest mortality occurs in the occupations in which admittedly dissipated habits prevail, or in which the persons employed are exposed to a continuous high temperature. Perhaps the latter circumstance induces the former. Amongst men may be instanced cabmen and blacksmiths, and amongst the women laundresses and cooks, as classes whose occupations have increased the mortality in small-pox. This increase is owing to the large number of hæmorrhagic cases developed under these conditions. In connection with the question of the influence of occupation and habits of life on the mortality of small-pox, much valuable information might be obtained from statistics collected in manufacturing districts compared with others from purely agricultural ones during the same epidemic.

TABLE I.—*Analysis of 3,555 Cases in which the number of Marks was noted, with Sex and Age.*

WITHOUT MARKS.

Age.	Males.			Females.			Total.		
	Ad- mitted.	Died.	Per centage.	Ad- mitted.	Died.	Per centage.	Ad- mitted.	Died.	Per- centage.
Under 5 .....	85	60	70.58	85	63	74.11	170	123	72.35
Between									
5 and 10 .....	100	51	51.0	67	37	55.22	167	88	52.69
10 and 20 .....	79	28	35.44	56	21	37.5	135	49	36.25
20 and 30 .....	55	31	56.36	43	23	53.48	98	54	55.10
30 and 40 .....	31	20	64.51	23	12	52.17	54	32	59.25
40 and 50 .....	8	3	38.0	4	3	75.0	12	6	50.0
50 and 60 .....	2	2	100.0	5	3	60.0	7	5	71.42
Over 60.....	1	—	—	—	—	—	—	—	—
Total .....	361	195	54.02	283	162	57.10	644	357	55.43

WITH ONE MARK.

Under 5 .....	5	1	20.0	10	3	30.0	15	4	26.6
Between									
5 and 10 .....	22	4	18.18	16	4	25.0	38	8	21.05
10 and 20 .....	107	8	7.47	73	16	13.69	180	18	10.0
20 and 30 .....	87	20	22.98	103	20	19.41	190	40	21.05
30 and 40 .....	40	7	17.5	29	6	20.71	69	13	18.98
40 and 50 .....	12	2	16.66	12	3	25.0	24	5	20.91
50 and 60 .....	3	1	33.3	5	1	20.0	8	2	25.0
Over 60.....	3	1	33.3	2	1	50.0	5	2	40.0
Total .....	279	44	15.77	250	48	19.2	529	92	17.39

WITH TWO MARKS.

Under 5 .....	5	2	40.0	4	2	50.0	9	4	44.4
Between									
5 and 10 .....	24	2	8.33	25	2	8.0	49	4	8.16
10 and 20 .....	210	11	5.23	175	8	4.57	385	19	4.93
20 and 30 .....	245	44	17.95	167	26	15.56	412	70	19.39
30 and 40 .....	91	22	24.15	65	9	13.84	156	31	19.87
40 and 50 .....	27	4	14.81	14	5	35.71	41	9	21.95
50 and 60 .....	10	2	20.0	6	1	16.66	16	3	18.75
Over 60.....	4	2	50.0	3	1	33.3	7	3	42.85
Total .....	616	89	14.44	459	54	11.76	1075	143	13.29

## WITH THREE MARKS.

Age.	Males.			Females.			Total.		
	Ad- mitted.	Died.	Per centage.	Ad- mitted.	Died.	Per centage.	Ad- mitted.	Died.	Per centage.
Under 5 .....	5	2	40·	6	1	16·6	11	3	27·27
Between									
5 and 10 .....	25	1	4·	21	—	—	46	1	2·17
10 and 20 .....	157	10	6·36	124	2	1·53	281	12	4·27
20 and 30 .....	130	17	13·07	98	13	13·26	228	30	13·15
30 and 40 .....	38	12	31·57	33	4	12·12	71	16	22·53
40 and 50 .....	19	6	31·57	11	3	27·27	30	9	30·
50 and 60 .....	2	—	—	1	—	—	3	—	—
Over 60 .....	1	—	—	—	—	—	1	—	—
Total .....	377	48	12·73	294	23	7·85	671	71	10·58

## WITH FOUR MARKS.

Under 5 .....	3	—	—	3	—	—	6	—	—
Between									
5 and 10 .....	13	—	—	18	1	5·5	31	1	3·22
10 and 20 .....	72	4	5·5	68	5	7·35	140	9	6·42
20 and 30 .....	67	10	14·92	47	1	2·12	114	11	9·64
30 and 40 .....	13	3	23·07	11	3	27·27	24	6	25·
40 and 50 .....	9	—	—	3	—	—	12	—	—
50 and 60 .....	3	1	33·3	4	—	—	7	1	14·28
Over 60 .....	—	—	—	—	—	—	—	—	—
Total .....	180	18	10·	154	10	6·49	334	28	8·38

## WITH FIVE OR MORE MARKS.

Under 5 .....	2	1	50·	1	—	—	3	1	33·3
Between									
5 and 10 .....	8	—	—	17	1	5·88	25	1	4·
10 and 20 .....	27	1	3·70	43	5	11·62	70	6	8·57
20 and 30 .....	42	1	2·38	42	2	4·76	84	3	3·57
30 and 40 .....	11	—	—	6	2	33·3	17	2	11·76
40 and 50 .....	2	—	—	1	—	—	3	—	—
50 and 60 .....	—	—	—	—	—	—	—	—	—
Over 60 .....	—	—	—	—	—	—	—	—	—
Total .....	92	3	3·26	110	10	9·09	212	13	6·13

TABLE II.—*General Summary at Different Ages.*

## MALES.

Age.	Without Marks.			With Marks.			Total.		
	Ad- mitted.	Died.	Per- centage.	Ad- mitted.	Died.	Per- centage.	Ad- mitted.	Died.	Per- centage.
Under 5 . . . . .	165	117	70·90	44	16	36·36	209	133	63·75
Between									
5 and 10 . . . . .	188	87	46·27	169	12	7·10	357	99	27·74
10 and 20 . . . . .	138	47	34·05	997	59	5·90	1135	106	9·42
20 and 30 . . . . .	96	51	53·12	1015	142	13·99	1111	193	17·37
30 and 40 . . . . .	54	30	55·55	332	69	20·78	386	99	25·67
40 and 50 . . . . .	16	9	56·25	120	28	23·3	136	37	27·94
50 and 60 . . . . .	2	2	100·	28	5	17·85	30	7	23·3
Above 60 . . . . .	2	2	100·	11	4	36·36	13	6	46·15
Total . . . . .	661	345	52·19	2716	335	12·33	3377	680	20·13

## FEMALES.

Under 5 . . . . .	144	102	70·83	39	9	23·07	183	111	60·10
Between									
5 and 10 . . . . .	150	81	54·	170	12	7·05	320	93	29·06
10 and 20 . . . . .	116	42	36·20	894	58	6·48	1010	100	9·9
20 and 30 . . . . .	120	41	34·16	791	82	10·36	911	123	13·50
30 and 40 . . . . .	36	17	47·2	245	43	17·95	281	60	21·35
40 and 50 . . . . .	15	6	40·	76	22	28·94	91	28	30·76
50 and 60 . . . . .	6	4	66·6	32	4	12·5	38	8	21·05
Above 60 . . . . .	—	—	—	10	2	20·	10	2	20·
Total . . . . .	587	293	49·74	2257	232	10·27	2844	525	18·49

## TOTAL OF BOTH SEXES.

Under 5 . . . . .	309	219	70·87	83	25	30·12	392	244	62·24
Between									
5 and 10 . . . . .	338	168	49·73	339	24	7·08	677	192	28·36
10 and 20 . . . . .	254	89	35·03	1891	117	6·18	2145	206	9·60
20 and 30 . . . . .	216	92	42·59	1806	224	12·40	2022	316	15·63
30 and 40 . . . . .	90	47	52·2	577	112	19·41	667	159	23·83
40 and 50 . . . . .	31	15	48·38	196	50	25·51	227	65	28·63
50 and 60 . . . . .	8	6	75·	60	9	15·	68	15	22·05
Above 60 . . . . .	2	2	100·	21	6	28·57	23	8	34·78
Total . . . . .	1248	638	51·12	4973	567	11·40	6221	1205	19·36

TABLE III.—*Occupations Classified.*

Occupations of Males over 20.	Vaccinated.			Unvaccinated.	
Trades.	Admitted.	Died.	Percentage.	Admitted.	Died.
Blacksmiths .....	10	5	50·		
Cabmen .....	12	6	50·	2	1
Painters .....	20	6	30·	2	1
Grooms .....	41	9	21·95	1	
Barmen, &c. ....	25	5	20·	3	1
Butchers .....	21	4	19·04		
Labourers .....	132	12	18·93	12	7
Bricklayers, &c. ....	32	6	18·75	2	1
Drapers and Hosiers, &c. ....	11	2	18·18	2	1
Jewellers .....	12	2	16·6	2	1

General percentage of mortality in Vaccinated Males over 20 = 16·46.

Shoemakers .....	20	3	15·	3	
Tinmen .....	14	2	14·29	3	1
Carmen .....	21	3	14·28	5	4
Tailors .....	15	2	13·3	3	2
Clerks, &c. ....	23	3	13·04	1	1
Carpenters, &c. ....	9	1	11·1	7	2
Gasfitters, &c. ....	9	1	11·1	1	
Costermongers, &c. ....	27	3	11·1	1	1
Porters .....	67	2	10·44	7	2
Coachmen .....	11	1	9·09	1	
Salesmen .....	14	1	7·14	1	

Occupation of Females over 20.	Vaccinated.			Unvaccinated.	
Trades.	Admitted.	Died.	Percentage.	Admitted.	Died.
Domestic servants, including Cooks .....	181	39	21·60	18	11
Laundress .....					
Sempstress .....					
	27	5	18·51	1	
	72	10	13·8	6	5

General percentage of mortality in Vaccinated Females over 20 = 13·35.

Charwomen .....	20	2	10	4	2
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I have thus endeavoured to briefly present to you some of the facts deduced from the analysis of over 6,000 cases of small-pox

treated during the present epidemic, one which for severity has not been surpassed since the practice of vaccination was generally introduced. In doing so I have without doubt but repeated what is to many of you an old story. But if, from the figures here adduced, the smallest iota of additional proof is furnished of the immense value of vaccination and revaccination as a protection against this most terrible disease, or if one of the many benefits to be derived from leading a temperate life is shown, I will think the time is not wasted which has been given to their collection and arrangement.









